DISRUPTIVE TECH RESEARCH

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IN HOT PURSUIT OF THE "HOLY GRAIL" OF MOBILE COMMUNICATIONS

Front and rear-facing cameras. HD-quality displays. Shiny, smooth metal cases. Ultra-responsive touch screens. Even fingerprint readers.

As consumers, we obsess over visible and tangible advancements in smartphone technology. Regrettably, we often fall into the same trap as investors, too. We get preoccupied with what can be seen, leading us into obvious and overcrowded investments. Like sapphire display maker, **GT Advanced Technologies Inc.** (GTAT).

But it's high time we realize the most lucrative mobile device investments reside in what's unseen. Why? Because the "guts" of mobile devices desperately need modernizing, as *MIT Technology Review's* David Talbot points out.

Nowhere is this need more felt than radio-frequency (RF) front-ends — the circuitry between the antenna and digital baseband responsible for analog signal processing.

"This is arguably the most critical part of the whole receiver," says Christopher Bowick in his book, *RF Circuit Design*.

Agreed. It's what enables phones to communicate wirelessly. And yet, remarkably, we still rely on an 83-year-old design approach. One, I might add, that's being stretched to its limits, thanks to our insatiable demand for always-on wireless broadband connectivity.

In short, if ever a market needed disruption, this is it. Enter **Resonant Inc.** (Nasdaq: RESN).

TOP IDEA:

Resonant

RESN

"Smartphones and tablets are… primitive and inefficient inside."

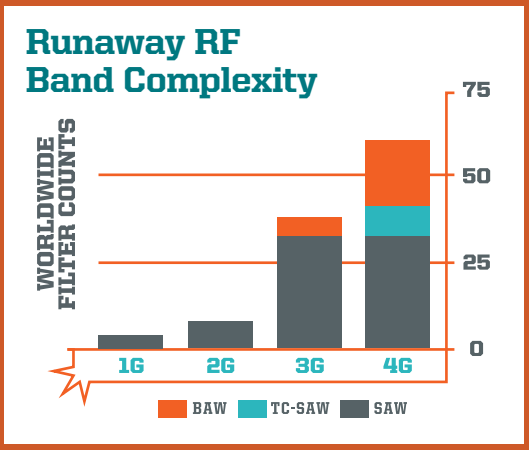
– David Talbot, MIT Technology Review.

3 MOST IMPORTANT FUNDAMENTALS:

- **MOBILE DEVICE GROWTH + MOBILE DATA EXPLOSION + INCREASING RF COMPLEXITY ELIMINATES COMMERCIALIZATION RISK.**
- **TECHNOLOGY RISK SIGNIFICANTLY REDUCED, GIVEN PROGRESS WITH TIER 1 CHIPMAKER, SKYWORKS.**
- **EARNINGS POWER + CONSOLIDATING INDUSTRY, DESPERATE FOR INNOVATION MAKES PRIME TAKEOVER TARGET.**

SEE LAST PAGE FOR IMPORTANT DISCLOSURES

SINGLE MOST IMPORTANT CHART:



Source: TriQuint Investor Presentation (Aug'14)

I'VE BEEN RESEARCHING RESONANT AND TRACKING ITS PROGRESS SINCE SEPTEMBER 2012

THE COMPANY'S IN HOT PURSUIT OF WHAT MANY INDUSTRY EXPERTS CONSIDER THE "HOLY GRAIL" – A TUNABLE RF FILTER.

RF filters are the critical electrical circuits that enable smartphones to transmit and receive data wirelessly.

Rest assured, this isn't some laughable, Monty Python-esque pursuit. Far from it. Resonant is a late stage development company, knocking on the door of commercialization.

Within weeks, I expect a major development milestone involving the $11.1 billion market cap, **Skyworks Solutions** (SWKS) to be made official.

By the end of the year, I expect the company to have its first, production-ready design finished and accepted, which could lead to revenue generation as early as the first quarter of 2015.

For those with little or no understanding of RF technology, the significance of Resonant's pursuit might be unclear. Let me first provide some basic, but essential background info, before moving onto a more in-depth review of why this multi-billion dollar market is in such desperate need of disruption. And more importantly, why Resonant is uniquely positioned to bring it about.

Essential Background 3
Investment Thesis 5
Market Dilemma 7
Disruptive Solution 10
Shorty Says 13
Intellectual Property 16
Valuation Matters 18
Upcoming Catalysts 20
Bottom Line 21
Tech Glossary 22
Important Disclosures 23

All wireless communications (radio, satellite, TV, cellular, GPS, etc.) travel over the air via radio frequencies. In order to receive the broadcasted signals, devices must be tuned to the right frequency or channel.

Traditional radio serves as the best illustration…

When you tune your radio to 95.5 FM, you're tuning into a station that is broadcasting at 95.5 megahertz. If you want to listen to a different station, you might turn the dial to 97.1 FM, which is broadcasting at 97.1 megahertz. And so forth. No two stations transmit over the same frequencies. Otherwise, it would cause interference.

Mobile phones operate in much the same fashion. They transmit and receive info over designated frequency bands or channels. Doing so requires blocking all unwanted channels, eliminating interference and only allowing the desired frequency band to pass. These tasks are accomplished with RF filters.

Here are the two key realities to understand in regards to Resonant:

1. **Each frequency band supported by a mobile device requires a separate RF filter to be able to "tune in" properly.**
2. **Each network (2G, 3G, 4G, etc.) includes multiple frequency bands.**

The end result? Multiple RF filters are required for a mobile phone to function properly.

Years ago, the need for separate RF filters was no big deal. The typical smartphone only needed to operate on four or five different frequency bands. Nowadays? Not so much.

The number of frequency bands keeps increasing. Case in point: The newly released iPhone 6 includes 16 to 20 RF filters for the LTE network alone, according to a recent analysis by Barclays' analysts.

Not only are more frequency bands in use today. But they're also technically more challenging to tune into. In other words, it's not a matter of simply adding more RF filters. More and more advanced RF filters are also required.

Understandably, higher filter counts and higher-performance requirements drives up costs. Even more so, since we've run out of real estate to keep adding filters within phones. In fact, smartphone companies presently make multiple versions of devices in order to support all the available frequency bands in different regions of the world.

KEY STATISTICS:

Three Month Stock Performance

52-wk range	$6.02 - $11.04
Shares Out.	6.9m
Float	3.1m
Insider Ownership	19%
30-Day Avg. Vol.	34,789
Market Cap.	$47.7m
Cash	$17.4m
Debt	$0
Patent Grants (Apps)	20 (20)
Analyst Coverage	N/A

Add it all up and we can appreciate why the pursuit of a tunable RF filter— a single filter that would be able to tune into multiple (5-6) frequency bands — is such a big deal.

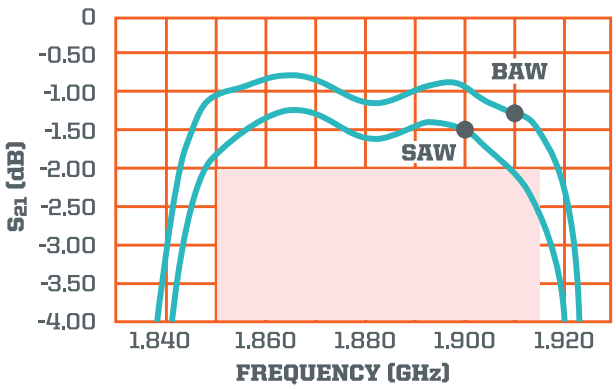
At a time when more and more frequency bands need to be supported, it would dramatically reduce the number of RF filters required and therefore, the cost and size of RF front-ends. It would make a truly global roaming phone possible, too.

With that basic understanding, we can now cut to the chase for the impatient ones and share our investment thesis. Afterwards, we proceed with an in-depth review of why the RF front-end industry is in such desperate need of disruption, why Resonant's uniquely positioned to bring it about, and what the shorts will inevitably try to say to convince you otherwise.

Three Main Types of RF Filters

Today's RF filters come in three main types:

Surface Acoustic Wave (SAW)
Low cost, easy to make and reliable, SAW filters are well suited for bands up to 1.5 GHz. However, SAWs suffer from sensitivity to temperature and decreased selectivity at higher frequencies (starting above 1 GHz). The current trends towards tighter receive and transmit bands also make SAW less suitable on some lower frequencies. SAW filters suffer from rounded corners on the response curve, which can result in a 1 dB increase in insertion loss at the edges, thereby reducing the passband.



Temperature-Compensated SAW (TC-SAW)
The reason SAW filters are less suitable at higher temperatures is because the substrate loses its stiffness. TC-SAW filters solve this problem by employing various methods to retain stiffness of SAW filters at higher temperatures and frequencies. However, TC-SAWs still aren't suitable for the highest frequency applications. And the temperature compensation increases the cost over a traditional SAW.

Bulk Acoustic Wave (BAW)
Superior performance with low insertion loss up to 6 GHz makes BAW filters the choice for the most challenging bands. Particularly, all the new LTE bands above 1.9 GHz. BAW-filters are a complimentary technology, employed in conjunction with SAW filters at lower frequencies. Because they involve three-dimensional structures, with multiple layers, the cost for BAW filters is higher, roughly double the price of SAW.

INVESTMENT THESIS

ARTICULATING THE ATTRACTIVE OPPORTUNITY AHEAD

Most disruptive technology investments take time to mature. Hence, our expected time horizon of 18 - 24 months. However, given the fundamentals below, the opportunity in Resonant could mature at a much faster pace…

Strong secular trend within existing mega-growth trend:

For years, I've said, "The exploding use of mobile devices promises to be the fastest-growing – and possibly biggest technological trend ever." Resonant represents an opportunity to invest in a secular trend within this larger trend. One that's growing at a faster clip, accelerating and still in the early innings.

The global smartphone market is expected to expand at a 15.3% CAGR through 2018, compared to an 18% CAGR for the RF filter market. Global LTE adoption, the main driver of RF band complexity, still represents less than 5% of all devices. But the adoption curve is expected to accelerate in the next several years. Much faster than the conversion to 3G unfolded.

Negligible commercialization risk for a high-value technology:

The explosion of mobile device and data usage, combined with runaway band complexity all but guarantees strong market demand for Resonant's products, once production-ready designs are complete.

Although RF filters already account for a multi-billion dollar market, costs continue to increase. This is not a niche opportunity. Instead, it's a high-value market ripe for disruption. Resonant represents the most likely disruptor, given its stage of development and the dramatic cost savings it offers customers (see pg. 12).

Customer agnostic model in intensively competitive market sets stage for rapid adoption:

Per the development agreement with Skyworks, Resonant retains all IP rights for the specific design. Even if Skyworks doesn't accept the final design, Resonant can still monetize it with another partner. Moreover, with 40+ separate bands available, Resonant can pursue unique opportunities with all industry players.

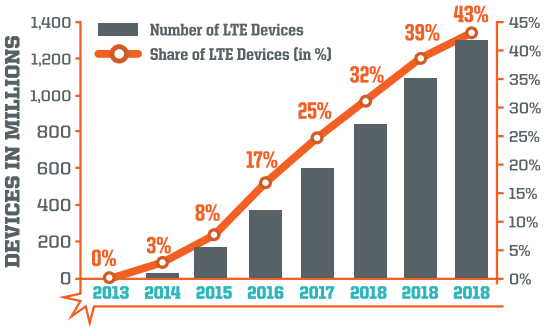
The fact the RF industry is a market of pennies, whereby a one-cent reduction in cost for an RF filter could result in millions in additional unit sales for a company, creates a strong incentive for all major players to work with Resonant. Otherwise, they'll be at a competitive disadvantage.

Short design cycles and use of standard process and materials for Resonant's ISN approach enables rapid market penetration.

"With smartphones growing faster than the overall handset market and containing more RF content, we expect our addressable market to grow faster than the overall handset market."

— RF Micro Devices (RFMD) annual report

LTE Accelerates



Source: Mobile Experts, TriQuint

Visible inflection point:

The company's close to completing its first production-ready design for leading chipmaker, Skyworks. Commercialization could begin as early as Q1 2015.

Moreover, technological risk is rapidly decreasing and being replaced by less significant engineering risk. Milestone #3 represents the last significant technological hurdle to commercialization. Upon successful completion, which I believe is imminent, an investment in Resonant becomes extremely asymmetrical in favor of upside potential.

Unique, defensible patent portfolio:

As detailed in the Intellectual Property section, my research did not identify any other company pursuing a similar design approach, let alone this close to commercialization. Management's IP strategy ensures the passage of time will only bolster the company's dominant IP position with dozens of additional patent applications.

Competent, qualified and incentivized management:

I'm not going to bore you with resumes you won't read. Suffice it to say, all executives possess significant industry — and technology-specific experience. They have direct connections with major industry players, too.

What's most meaningful to me, though, is that all three founders provided capital to seed the company and initially worked without pay. Add in a 19% ownership stake and their interests are well aligned with ours.

High-margin, recurring revenue model makes Resonant an obvious takeover target:

The RF industry's already consolidating. Earlier this month, Japanese chipmaker, Murata announced an acquisition of Peregrine for $465 million (at a 63% premium). In August, Infineon Technologies announced a $3 billion deal for International Rectifier Corp. And back in February, RF Micro Devices agreed to buy TriQuint for $1.6 billion.

Resonant's disruptive technology and high-margin, recurring revenue business model naturally makes it a prime takeover target. The key is securing multiple partners to instigate a bidding war.

No analyst coverage:

Study after study confirms the lack of attention creates tremendous inefficiencies, which we can strategically exploit. But don't expect this informational advantage to last indefinitely. Or very long at all. On September 24, Ascendiant Capital Market's semiconductor analyst, Cody Acree, hosted a teach-in with institutional investors. I believe it's a precursor to official coverage.

Additional Considerations

Although not central to our investment thesis, these factors also warrant consideration:

Thinly traded: 30-day average trading volume of less than 35,000 shares per day.

Seasonality: The first quarter is typically the slowest for Skyworks. This could lead to slightly lower initial revenue for Resonant. It all depends on the specific band, though. Regardless, the initial sales amount isn't material. Officially commercializing the product is what matters most.

Additional tech validation: The company's engaged in active discussions with other leading chip companies, based on public comments. Although the Skyworks agreement is more than sufficient, any additional deals will provide even more validation of Resonant's disruptive technology.

Capital light licensing model mitigates dilution risk: Resonant plans to charge a royalty at a fixed amount per filter and not as a percentage of sales. With no manufacturing costs, $16.7 million in working capital, a $1.25 million quarterly burn rate and near-term visibility on revenue, the likelihood of dilution in the next year is minimal.

After reading the 10ks, listening to the quarterly conference calls and reviewing the investor presentations from nearly every major RF solution provider, one thing's clear — the entire industry is facing some daunting challenges, which makes it overdue for disruption.

BIG DATA, BIG PROBLEMS

As we can all attest, mobile devices aren't simply cool gadgets. They've become vital to survival. Case in point: 91% of us are within arm's length of our smartphones at any given moment, according to Morgan Stanley data. We're constantly texting, checking email, surfing the internet, tweeting, gaming, streaming video. The list goes on.

The problem? Smartphones use 24 times more data than a traditional cell phone. Consequently, our always-connected lifestyles, full of high-bandwidth, data-intensive activities are straining the mobile communications network.

There's no relief in sight, either. Not with smartphone costs declining and in turn, penetration rates climbing.

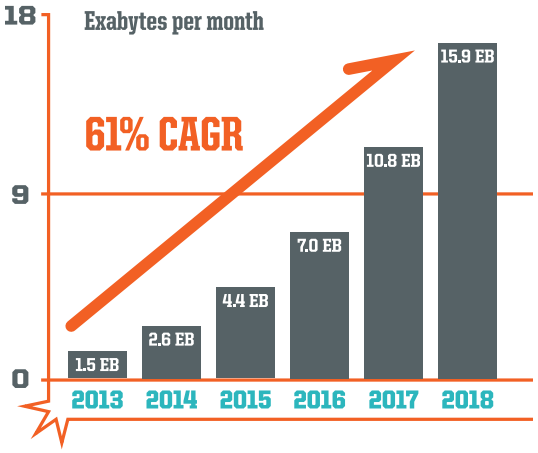
Consider: Later this year, consumers in India and Indonesia will be able to purchase a smartphone, powered by Mozilla Corp.'s software, for $25. *(That's not a typo).*

Is it any wonder, then, that eMarketer expects smartphone penetration rates to hit nearly 50% within three years, up from just 27.6% at the end of 2012?

With the number of smartphone users swelling, it's only natural for data demands to explode higher, too. Sure enough, Cisco predicts worldwide mobile data traffic is going to increase 61% (CAGR) from 2013 to 2018.

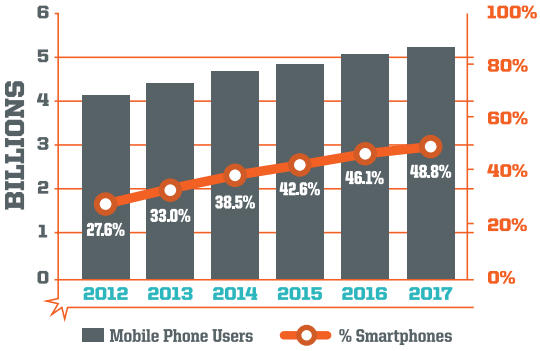
Meeting exploding data demands is an increasingly urgent and pressing issue for the industry. But it's not the only challenge.

Mobile Traffic Growth



Source: Cisco Visual Networking Index (Jun'14)

Smartphone Penetration



Source: eMarketer (Dec'13)

RUNAWAY BAND COUNTS, COMPLEXITY & COSTS

Consumers are spoiled. We expect to stay connected, at high-speeds, all the time. No matter what. And ensuring that's possible in the future is not as simple as flipping a switch.

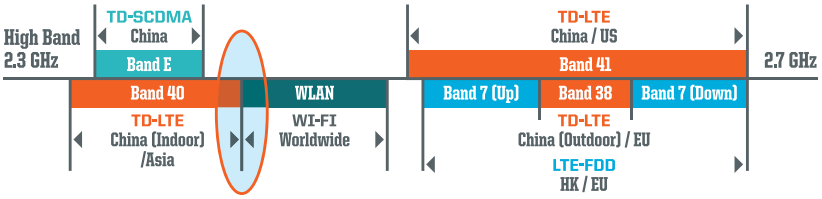
First, more spectrum needs to be made available. Then, new filters need to be added to devices to enable them to communicate on the new bands. However, backward compatibility requirements (the need to support legacy bands on older networks) means old filters can't be removed. As a result, band counts keep climbing higher. Fast.

Industry insiders envision a day in the near future when a high-end smartphone will include 50 or more filters. We're well on our way there. Take the latest iPhone, introduced weeks ago, for example. It supports up to 20 different LTE bands. That compares to as few as seven bands on the previous generation devices (iPhone 5s and 5c).

This isn't simply a matter of adding more filters, though. The situation requires more and more advanced filters. Why? Because more bands means mitigating more interference. Plus, many new bands operate at higher frequencies, which require higher performance filters (BAW instead of SAW). As if adding more filters wasn't costly enough, adding more advanced filters further drives up costs.

Spectrum overcrowding only complicates matters more. In order to maximize spectrum, guard bands are being reduced significantly. Others are being completely eliminated, like in the case of Band 40 and the Wi-Fi Band in China. There is absolutely no gap. Understandably, these tighter operating specifications requires more advanced filtering technology.

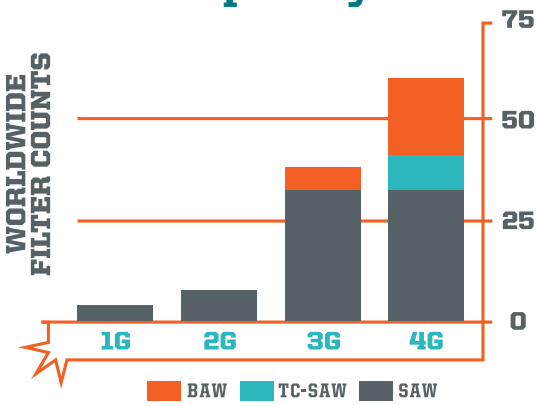
Look ma, no gap!



Source: Digitimes.com (Jan'14)

Regional differences in spectrum allocation add another layer of complexity. At the end of July, there were 318 commercial wireless networks in 111 countries. It's not possible to support that much diversity in a single device. Even supporting differences within regions of the world is becoming increasingly complicated.

Runaway RF Band Complexity



Source: TriQuint Investor Presentation (Aug'14)

"RF interference rejection will become ever more challenging as emitters of all types proliferate, more wireless bands are allocated at higher frequencies and global spectrum management remains a fragmented process."

– Robert Aigner, TriQuint

NO MORE LAND BEING MADE

Remember, every supported band means a separate RF filter is needed. Unfortunately, real estate is scarce within devices to accommodate more and more filters. In some cases, it's shrinking.

Why? Because smartphone manufacturers want to pack larger and larger batteries into thinner, more compact designs, leaving less space for components. Hence, the buzzword "miniaturization" is being bandied about by leading RF component companies.

Keep in mind, too, design cycles are lightning fast. The average market life cycle for a new phone is a mere eight to 12 months, according to Brightstar's 2014 Mobile Trends Report. Meanwhile, the average user only keeps a phone for 22.4 months, based on the latest data from Recon Analytics.

Add it all up and incremental improvements to traditional RF front-end designs can no longer be expected to meet the ever-increasing performance and space requirements. Not without costs soaring to prohibitive levels. Or more simply the industry's ripe for disruption.

Increasing Cost of RF Front-Ends

	TYPICAL 3G	REGIONAL LTE	GLOBAL ROAMING LTE	IPHONE 5S/C	IPHONE 6
SAW Filters	$1.25	$2.00	$2.25	—	—
TC-SAW filters	—	$0.50	$1.50	—	—
BAW filters	—	$1.50	$3.50	—	—
Total Filter	$1.25	$4.00	$7.25	$5.55	$9.59
Amplifiers / switches / other	$2.50	$3.50	$5.50	$7.48	$6.30
Total RF Content	**$3.75**	**$7.50**	**$12.75**	**$13.03**	**$15.89**

Source: TriQuint, Barclays

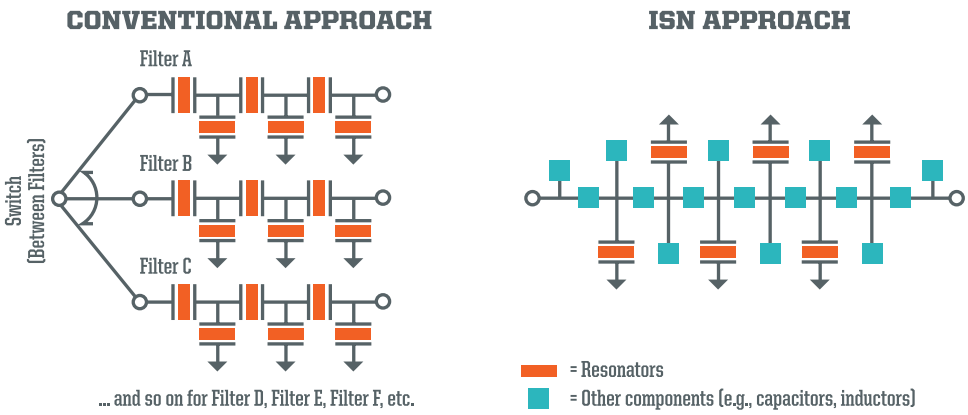
The entire RF industry relies on a design approach that dates back to 1931. It's known as the "acoustic wave ladder." The problem is it's no longer capable of addressing the difficult design challenges for RF filters. That's where Resonant comes in.

The company's pursuing two disruptive solutions, both of which rely on a new and novel design approach called Infinite Synthesized Networks (ISN).

According to Resonant's S-1filing, ISN represents the "biggest fundamental change to mobile device filter design in more than 80 years." Sounds promotional at face value. That is, until you see a side-by-side comparison of the two approaches.

"Biggest fundamental change to mobile device filter design in more than 80 years."

– Resonant's S-1 filing



The conventional approach to RF filter design relies on a single component – resonators. Only one topology (or configuration) is possible. In contrast, ISN uses additional components, including capacitors and inductors, which enables the company to develop an infinite number of topologies. It can then select the optimal design for each specific band.

SEEING SOLUTIONS WHERE OTHERS CAN'T

Resonant's approach to filter design is so radical and unconventional, when most industry experts first see it, they don't "see it." They don't get how the ISN approach works. Or they don't believe it works because it defies convention and tradition. But the smart guys always say it's impossible until they realize it is possible.

Sure enough, throughout my research process, I uncovered multiple "conversion" accounts — industry experts who start off extremely pessimistic about ISN, but upon closer examination become believers. We can even count current CEO, Terry Lingren, among this group.

This is a classic example of being too close to a problem to see the solution. Conditioned by decades of using the acoustic wave ladder approach, industry insiders are pre-programmed to approach new filtering challenges with the same techniques.

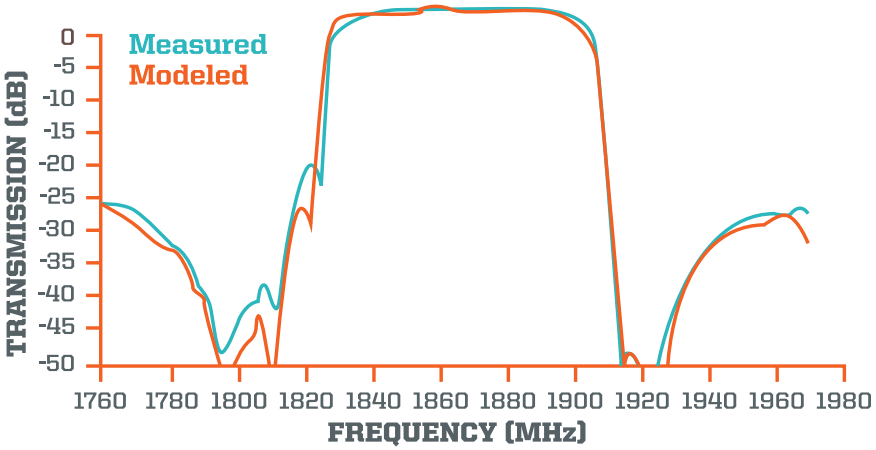
What makes Resonant the exception? It's history. ISN wasn't created to solve RF filtering challenges in the mobile handset market. Instead, it traces its roots back to applications in superconducting wires.

The basis for ISN was actually pioneered in 2005 by **Superconductor Technologies** (SCON), as part of its development of high temperature superconducting wire.

To make a long story short, the CTO at Superconductor, and now a co-founder of Resonant's, realized the unique approach they developed for filtering involving superconducting materials should also work in non-superconducting materials.

I'm well aware, as Yankee legend, Yogi Berra, once warned, "In theory there is no difference between theory and practice. In practice there is." Thankfully, in this case, there is not. Expected performance modeled by ISN does match the measured performance of actual filters.

Theory vs. Practice



Source: Resonant Investor Presentation (Aug'14)

Transformational Technology Benefits

There are three key benefits to Resonant's approach:

1. Smaller, lower cost. Complex filtering challenges can be met for half the price of traditional designs. In less space, too.

2. Improved performance. ISN improves key filter performance metrics, including insertion loss and steepness of rejection. This enables ISN to address the most difficult filtering challenges.

3. Combinations possible. Filters designed using ISN can operate at multiple frequencies (i.e. – tunable). In other words, operability for multiple bands can be combined into one filter.

It's also important to note, ISN doesn't involve disrupting the fabrication process. Although it represents a new circuit design, it uses standard lithography and materials. As a result, we can expect Resonant's filter designs to be quickly and easily adopted.

The company's leveraging its novel ISN methodology to commercialize two separate solutions:

DISRUPTIVE SOLUTION #1:
SAW WITH BAW CAPABILITIES

Resonant is in the final stages of developing its first SAW duplexer, which can replace a larger, more expensive BAW duplexer at a significant cost savings. Management's initial estimates suggest they can replace a $0.62 BAW duplexer with $0.28 SAW duplexer. That's a 55% cost reduction without any sacrifice in performance.

It's critical to note, too, this isn't a feasibility project. It's a development agreement with a specific customer (Skyworks) to deliver a commercial-ready duplexer for a specific, undisclosed band. Moreover, royalty rates have already been set. Once Resonant meets the remaining milestones and the design is accepted, revenue could start being realized before the end of the first quarter of 2015.

For reference, the development agreement contains the following progress milestones:

- **Milestone #1: Resonators.** Design a set of resonators, fabricate using an approved high volume manufacturer and provide test results. ***Completed***
- **Milestone #2: Filters.** Design the first iteration of a fully- packaged duplexer, fabricate using the approved manufacturer, provide test results and deliver samples. ***Completed***
- **Milestone #3: Duplexers.** Design the second iteration of a fully-packaged duplexer, fabricate using the approved manufacturer, provide test results and deliver samples. ***Completion Imminent***
- **Milestone #4: Qualified Chip.** Design production-ready, fully-packaged duplexer, fabricate using the approved manufacturer, provide test results and deliver samples. ***Completion by Q4 2014***

DISRUPTIVE SOLUTION #2:
THE FIRST TUNABLE FILTER

Resonant believes ISN can be used to develop a series of tunable filter designs. The company's already demonstrated an ability to develop a tunable filter for two bands (Band 5 and Band 8).

Before the year is out, management plans to begin work on a tunable filter with three to four-band capability.

Ultimately, Resonant believes ISN holds the potential to replace 40-50 filters with two to three tunable filters. In addition to the obvious space savings, the company estimates its tunable filters could reduce average front-end filter costs by 46%.

Again, management wants to work on a product, not a feasibility project. To that end, management has publicly confirmed discussions are underway are with industry leaders to develop a tunable filter for a specific, commercial application. Skyworks has been specifically mentioned. My sources suggest the company has also spoken with **TriQuint**, as well as **Murata**.

DISRUPTIVE TECHNOLOGY COMPANIES OFTEN FACE BASELESS ATTACKS FROM OPPORTUNISTIC SHORT SELLERS

This leads to increased market volatility. Instead of fearing it, we need to embrace it. Volatility comes with the territory of investing in disruptive technology companies.

That said, advance preparation goes a long way in ensuring we don't reflexively and prematurely exit our positions. With that in mind, here's a rundown on the most likely areas of attack, with and without merit:

SHORTY SAYS:
NOTHING BUT SNAKE OIL

The most common attack against disruptive technologies is that the technology doesn't work. Shorts will insist Resonant's claims of SAW filters with BAW capabilities amount to nothing more than a compelling sounding story. Or even worse, it's a blatant fraud or promote.

In this case, shorts will anchor their "tech doesn't work" argument on the fact Resonant's technology was "halted" by Superconductor in 2010, before being "scrapped" via a spin-off in 2012. But if that were true, wouldn't Superconductor have simply cut its losses and moved on? It didn't do that, though. Instead, Superconductor committed additional resources, including software, equipment and office space to the spin-off. They also made an initial investment in Resonant.

In truth, the spin-off of Resonant had nothing to do with the technology not working. Instead, it had everything to do with strategy. Superconductor wanted to focus the majority of its resources on its core business of commercializing superconducting wires.

"There is no technology today that can produce tunable filters or duplexers with acceptable performance."

— N. Quinn Bolton of Needham & Company

SHORTY SAYS:
THE HOLY GRAIL DOESN'T EXIST.

Shorts will likely try to bolster the "tech doesn't work" argument by suggesting more plainly that the idea of a tunable filter is laughable, at best.

They'll usher in proof that much larger, more experienced firms like Japan's Murata or TriQuint have been working on tunable filters for years, to no avail.

That's true. The pursuit of a tunable RF filter has been going on for years without any notable progress.

They'll share quotes from industry analysts scoffing at the idea of a commercially viable tunable filter. Like the one from N. Quinn Bolton of Needham & Company.

That's true, too. No technology has been able to produce an "acceptable" tunable filter. But there's a good explanation for it. Everyone's been trying to create one within the framework of the acoustic wave ladder approach.

Some try to do it by swapping out the classic piezo-material, AIN, for other Ferroelectric materials like BST. Others focus on alternative placements of tunable materials within the BAW filter design. Others still experiment with methods that involve higher voltage to increase tuning range, or additional components, which increases the cost and size of the RF front-end.

All these attempts are destined to fail. Why? If you want the specific reasons, check out Director of R&D at TriQuint, Robert Aigner's paper — *Tunable acoustic RF-filters: Discussion of requirements and potential physical embodiments.*

If you want the simple answer, it's this — a commercially suitable tunable filter probably isn't possible with the acoustic wave ladder

approach. But remember, Resonant's not using the same approach. It uses a radically different approach, backed by early results that assert a tunable filter is, indeed, possible. Don't let the shorts convince you otherwise.

SHORTY SAYS:
WE'RE TALKING ABOUT ~~PRACTICE~~ A DEVELOPMENT AGREEMENT:

Like Allen Iverson in his infamous press conference, the shorts are bound to downplay the significance of the agreement with Skyworks. It's just a development agreement (i.e. — practice), they'll say. It's not an actual contract (i.e. — a game) that binds Skyworks to actually purchase anything from Resonant.

While factually accurate, we need to take context into account. The collaboration with Skyworks dates back at least five years. There's no reason to "mess around" with Resonant for that long if the technology isn't legitimate and progressing towards a meaningful endpoint. Nor is there any reason to pre-negotiate royalty rates. Therefore, Skyworks' continued engagement points to a high probability of success for Resonant. This is more than just practice.

SHORTY SAYS:
SOMEBODY CALL THE COPS

Another likely angle of attack for shorts involves theft. They'll contend, if Skyworks is serious — and the technology actually works — the company will just steal the technology from Resonant.

That's always a possibility when small companies share new innovations with larger, more established ones. But that's where Resonant's strong and expanding IP portfolio comes in.

It serves to discourage Skyworks from stealing the technology, as patents establish a clear history of ownership. Likewise, Resonant is working closely with Skyworks' fabs. That makes plausible deniability impossible for Skyworks because additional parties know the real owner of the technology.

In today's hyper competitive world, being first-to-market is no longer a sustainable competitive advantage for companies developing new technologies. Only operating companies with a commitment to building a robust, unique and defensible patent portfolio stand a chance at true, long-lasting disruption.

For small companies, a strong patent portfolio improves negotiating leverage, prevents technology theft and in many cases, attracts strategic buyers.

On a more fundamental level, patents sort out the pretenders from the true disruptors. Accordingly, I put a high value on IP when evaluating companies and Resonant ranks high, as indicated by the summary statistics in the sidebar.

Of particular note, a patent grant and app search for "tunable radio frequency filter" turns up only 11 results (10 grants, 1 apps). And Resonant accounts for the majority (54%) of the IP (see pg. 17 for details).

The earliest IP belongs to **Blackberry** (BBRY). Based on my review, it uses the conventional design approach. But it involves using ferroelectric tunable materials, changing voltage and only envisions combining two filters into one. Robert Aigner's paper sums up the shortcomings of such pursuits.

Alcatel-Lucent (ALU) is the next in line. It appears to deviate from the acoustic wave ladder approach, by using what it refers to as "filter unit cells." However, no additional grants or apps have been filed, which suggests the technology doesn't work as envisioned and/or the company's halted development. Alcatel's approach differs significantly from Resonant's approach, so I'm not concerned about Resonant infringing.

Thales SA (THLEF) involves using different materials and the placement of tunable filters, specifically allowing them to rotate to improve tuning capabilities. Again, we're still operating within the traditional design approach, changing variables with limited impact on achieving tunability, as Aigner noted.

Moving on to **Nokia** (NOK), its oldest patent involves a nanotechnology approach to develop resonators using carbon nanotubes. Much like with Alcatel's patent, the difference in approach and lack of subsequent development eliminates any infringement or competitive risks for Resonant. Nokia's other patent (8,761,709) focuses on reducing interference among various components within mobile phones, not tunable filters.

Add it all up and Resonant boasts the most extensive and unique IP portfolio in relation to tunable filters. With more patent applications in process, I only expect Resonant to extend its lead in the pursuit of the first, commercially viable tunable filter.

Disclaimer: I'm not a patent expert or an engineer. The conclusions drawn above are based on my own interpretation of the information contained in the patent documents. I've included all document numbers so you can easily find and independently review them.

Key IP Statistics

- **20 patent grants, plus 20 applications (as of 9/29).** That's up from 18 grants and 17 apps at the time of its May IPO, indicating management's commitment to strengthening its IP portfolio.
- **Dozens more patents in process.** I expect Resonant's portfolio to top 50 total grants and applications by the end of 2014.
- **Meaningful concentration.** By my estimates, 80% of Resonant's IP relates to its ISN methodology. Given that ISN is a core differentiator for RESN, it's encouraging to see that the majority of its IP protects the unique approach. These could prove foundational *(i.e. – highly valuable)* once commercialization and market penetration ramps up.

IP Search For "Tunable Radio Frequency Filter"

DOCUMENT #	TYPE	COMPANY	TITLE	DATE FILED/GRANTED
6,683,513	Grant	**Blackberry** (BBRY)	Electronically tunable RF diplexers tuned by tunable capacitors	01/27/04
7,593,696	Grant	**Alcatel-Lucent** (ALU)	Tunable radio frequency filter	09/22/09
7,639,101	Grant	**Resonant** (RESN)	Low-loss tunable radio frequency filter	12/29/09
7,719,382	Grant	**Resonant** (RESN)	Low-loss tunable radio frequency filter	05/18/10
7,791,433	Grant	**Nokia** (NOK)	Apparatus, method, and computer program product providing edgeless carbon nanotube resonator arrays	09/07/10
7,843,286	Grant	**Thales SA** (THLEF)	Dielectric resonator filter having a tunable element eccentrically located and a method of production thereof	11/30/10
7,863,999	Grant	**Resonant** (RESN)	Low-loss tunable radio frequency filter	01/04/11
8,063,714	Grant	**Resonant** (RESN)	Low-loss tunable radio frequency filter	11/22/11
8,761,709	Grant	**Nokia** (NOK)	Controlling a receiver	06/24/14
20140197905	App	**Resonant** (RESN)	Low-loss tunable radio frequency filter	07/17/14
8,797,120	Grant	**Resonant** (RESN)	Low-loss tunable radio frequency filter	08/05/14

Traditional valuation metrics don't apply to most disruptive technology companies. Ditto for price targets. Why? Because there's no objective way to measure or calculate either for a company that has little to no sales and earnings history.

Instead, valuations for disruptive technology companies are a function of the total addressable market and the company's likelihood of penetrating a meaningful amount of the market.

Here are the relevant figures for Resonant…

Total RF Front-End Market: $13 billion or $17 per handset

Mobile Experts forecasts the RF front-end component market will reach $8.9 billion in 2014, rising rapidly to over $13 billion in 2018. To put the numbers in more understandable terms, Skyworks pegs the addressable market for RF front-ends at about $10 device today, expanding to about $17 by 2018.

Total RF Filter Market: $6 billion or $8.50 per device

Based on the latest figures from Navian, duplexers and bandpass filters represent a market worth $3.1 billion today, rising to over $6 billion by 2018. Again, it's instructive to put the numbers into easy to understand terms. In this case, we're talking about an addressable market of up to $8.50 per device.

RESONANT: THE NEXT ARM HOLDINGS?

UK-based, **ARM Holdings** (ARMH) serves as a good proxy for the opportunity ahead of Resonant.

For those unfamiliar, the company is a leading innovator in the microprocessor space. It derives the majority of its $1.2 billion in annual sales from small royalty fees on mobile devices. Just like Resonant plans to do.

Over the last decade, ARM's gone from about $200 million in annual revenue to more than $1 billion. And it boasts a market cap of $21 billion, which works out to a price-to-sales ratio of 17.3.

As you can see in the table below, even if Resonant only penetrates a small portion of the addressable market for RF filters, it could easily earn upwards of $1.00 per device. With annual smartphone sales expected to hit 2 billion by 2018, according to ABI Research, Resonant's annual revenue potential could easily top $700 million.

If we apply the same market multiple as ARM, Resonant could eventually command a $12 billion market cap. Given the company's current market cap of $48 million, we're talking about the potential for a 250Xreturn.

Please understand, those calculations are for illustration purposes only. But the exercise does show what's possible, if Resonant can successfully penetrate the RF filter market and remain independent.

One last thing – dilution poses a big valuation risk for early stage tech investments. To be clear, there's good dilution, when things go right and money is needed for growth purposes. And then there's bad dilution, when commercialization is delayed and the company needs capital just to keep operating.

In Resonant's case, however, the dilution risk is mitigated. Not only does the company have approximately 14 months of runway at the current burn rate of $1.25 million per quarter. But it also should start generating meaningful revenue within the next six to nine months.

"Back of the Napkin" Revenue Calculations

FILTER DESIGN WINS	ENABLED MARGIN (PER DEVICE)	REV PER DEVICE @ 35% ROYALTY	TOTAL REV	
			@ 1B DEVICES	@ 2B DEVICES
1 single band	$0.34	$0.12	$119,000,000	$238,000,000
2 single bands	$0.68	$0.24	$238,000,000	$476,000,000
3 single bands	$1.02	$0.36	$357,000,000	$714,000,000
1 tunable	$1.00	$0.35	$350,000,000	$700,000,000

Instead of obsessing about sales and profit growth like most investors, we're primarily concerned with a company's progress. More specifically, whether or not management remains on track to reach key development milestones.

If so, share prices stand to benefit. If not, they promise to suffer until management gets back on track.

Here are the key milestones to track for Resonant, as well as any expected completion dates:

Skyworks Milestone #3: The most significant milestone, in my opinion because it involves the delivery of a final, fully functional design. Once reached, it means the major technology risk has been mitigated.

We could receive official word on this milestone as soon as September 30. I say that because the company reported quarterly results on August 13. However, management scheduled another conference call for the last day of September.

The only reason for a call so soon after the last update makes sense is to announce the completion of this milestone. If it's not officially announced then, I expect it be announced within weeks.

Skyworks Milestone #4: This milestone involves standard quality testing. Any problems that arise would involve engineering risk, not technology risk.

For instance, the fabrication process might have to be fine-tuned to maximize yields. But that's more easily overcome than if the technology itself didn't work.

Management expects to reach this milestone by the end of 2014. But it's possible they could announce it sooner, perhaps on the next quarterly conference call in mid-November.

Tunable Filter Development Agreement: Before the end of the year, management plans to begin work on a tunable filter product, not project. To do so, they need to reach a development agreement with a customer to design to a spec. Management recently confirmed discussions are underway with potential partners.

Skyworks Commercialization: Upon completion of milestone #4, Skyworks has an option to lease Resonant's duplexer design at agreed-upon royalty rates. My research suggests the decision needs to be made within 30 days to 45 days. Otherwise, Resonant can approach additional interested parties.

Depending on the swiftness of an acceptance and incorporation into a chip, Resonant could start earning revenue as early as the first quarter of 2015. On the outside, I expect revenue recognition to occur by June 30, 2015.

Other Important Dates

IPO lock-up expiration:
November 25, 2014

Third quarter conference call:
Mid-November

Insider lock-up expiration:
May 29, 2015
Includes shareholders owning 5% or more at time of IPO

WITH SHARES TRADING CLOSE TO THE MAY IPO PRICE – AND A CONFIRMED MULTI-BILLION DOLLAR OPPORTUNITY IN FRONT OF RESONANT – WE'D BE HARD PRESSED TO FIND A MORE ATTRACTIVE RISK VERSUS REWARD OPPORTUNITY IN THE MARKET.

Especially since my research suggests we're weeks away from the company announcing a critical technology milestone. Once hit, it promises to noticeably reduce the risk associated with the stock.

Even if Resonant fails to commercialize it's second disruptive solution — a production-ready tunable filter – the company still represents an attractive investment.

The opportunity in lower cost, higher performance SAW filters still represents a $500 million gross profit opportunity. And yet, Resonant currently trades at a market cap of less than $50 million.

With shares trading at $6.90, speculators should consider entering a position in the stock for less than $8.

More risk-averse investors should wait until after Skyworks green lights the current development project for commercialization.

Waiting for such a development will reduce the risk associated with an investment. But it'll likely involve sacrificing some meaningful upside, too.

Do your own diligence before you consider investing a single penny. It's your money and your responsibility.

Ahead of the tape,

Louis Basenese

TECH GLOSSARY

MAKING DISRUPTIVE TECHNOLOGIES EASY TO UNDERSTAND

We're committed to making disruptive technologies easy to understand. Sometimes we simply can't avoid using more technical jargon, though. With that in mind, please find below a glossary of potentially unfamiliar tech terms and concepts used throughout this report.

BAND, CHANNEL OR FREQUENCY BAND:

A designated range of radio wave frequencies used to communicate with a wireless device.

BAND-PASS FILTER:

A series of interconnected resonators designed to pass (or select) a desired radio frequency signal and block unwanted signals.

BAND-STOP FILTER OR BAND-REJECTION FILTER:

A filter that passes most frequencies unaltered, but attenuates those in a specific range to very low levels. It is the opposite of a band-pass filter.

CAPACITOR:

A device used to store an electric charge, consisting of one or more pairs of conductors separated by an insulator.

DUPLEXER:

Two RF filters combined into a single component, which simultaneous selects both the transmit and receive signal.

INDUCTOR:

A passive electrical component that generates a magnetic field when a current is passed through it and stores the energy in the form of the magnetic field.

INSERTION LOSS:

The loss of signal power resulting from the insertion of an RF filter, expressed in decibels (dB). The acceptable range is less than 3dB.

RESONATOR:

A device that naturally oscillates (or resonates) at specific frequencies. The oscillations in a resonator can be either electromagnetic or mechanical (including acoustic). Resonators are the building blocks for RF filters.

RF FILTER:

An electrical circuit configuration designed to enhance signals at certain radio frequencies or attenuate signals at undesired radio frequencies.

RF FRONT-END:

The circuitry in a mobile device responsible for the analog signal processing which is located between the antenna and the digital baseband.

SEMICONDUCTOR FABRICATION PLANT OR FAB:

A manufacturing plant in which raw silicon wafers are turned into integrated circuits, typically on a contract basis for other companies.

DISRUPTIVE

TECH RESEARCH